

LA-UR-79-2947

TITLE: STATISTICAL EVALUATION OF LICENSEE EVENT REPORTS

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MASTER

SUBMITTED TO: ANS Topical Meeting on
Thermal Reactor Safety
Knoxville, Tennessee
April 8-11, 1980

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478

STATISTICAL EVALUATION OF LICENSEE EVENT REPORTS¹

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Approximately 8 700 licensee event reports (LERs) were submitted by the licensees of US commercial nuclear power plants from 1976 through 1978. For several reasons, the number of LERs varies from unit to unit. These variations are important because they are often viewed by government agencies and the public as indications of relative safety. While such variations may be indicative of actual differences in safety among nuclear power units, there may be other explanations. It is therefore important to understand all possible explanations and their contributions to variations in the numbers of LERs from unit to unit.

Certain differences in the frequency of submission of LERs from unit to unit will occur as a result of the apparently random nature of the events being reported. Because of this "randomness," it is probable that variations will occur in the reporting rate for LERs, even among identical nuclear power plant facilities with identical failure component probabilities. In reality, however, variations beyond those resulting from "randomness" frequently will be observed. Several factors support this.

(1.) Technical specifications and license provisions vary among nuclear power plant facilities because of differences in reactor suppliers, architect/engineers, constructors, and design changes over the years. These variations cause differences in the reporting requirements among facilities.

*Work performed under the auspices of US Nuclear Regulatory Commission.

(2.) At some facilities events may be reported more readily than at others in marginal cases. This consideration pertains to events other than obvious "reportable occurrences" (ROs), which all licensees must report.¹ This tendency can also change with time.

(3.) The occurrence of an event may affect the probability of future events. Repair of a facility component or improvement of a deficient procedure may reduce significantly the likelihood of an associated event. However, ineffective corrective action following an event may result in its repeated occurrence.

(4.) The mode of operation (e.g., on-line or shutdown) affects the frequency of various kinds of inspections and the susceptibility of systems to random failures. The amount of reactor down-time, for example, may affect the frequency with which LERs are submitted.

(5.) Misinterpretations by licensee or NRC personnel involved in the preparation, submission, and processing of LERs can affect relative reporting frequencies among reactor systems.

(6.) At some multiunit power stations for example, Oconee and Brown's Ferry, events involving plant systems or components common to all units, such as swing diesels and electrical switchyards, are filed in the NRC data bank under the docket number of the first unit.

(7.) The existence of safety-related deficiencies at an individual facility should result in more frequent submission of LERs. Differences in the number of LERs from this cause should be a measure of relative safety.

Although the above factors affect the frequency with which LERs are reported, their effects are often relatively small. Frequently, the variations produced by these effects are too small to be distinguished from those occurring on a random basis. For example, the Point Beach Nuclear Station in 1976 had 11 reportable-occurrence LERs for Unit 1 and 16 for Unit 2. Does this necessarily indicate that one or a combination of the causes

listed above produced this difference, or is it possible that a deviation of this magnitude could have been expected if both units had the same average probability of occurrence of reportable events? Statistical analysis indicates that 11 and 16 in one year are both consistent with average occurrence rates in the range of one per 20 days to one per 37 days (10-18 per year). In fact, the pair of numbers, 11 and 16, is the most probable one-year outcome for two units with an average rate of one per 27 days (13.5 per year). In 1978, the Zion Nuclear Station had 85 reportable-occurrence LERs for Unit 1 and 39 for Unit 2. In this case, the deviation in the number of LERs between the two units is too large to be attributed solely to random effects. If randomness alone were involved, Unit 1 probably could not have had a reporting rate less than one per 5.2 days (70 per year), while Unit 2 probably could not have had a rate greater than one per 7.2 days (51 per year). In fact, if both Zion units had identical probabilities of reportable events, there is no more than one chance in one million that a deviation this large could occur by chance.

Naturally, there are differences between the Point Beach units. Unit 1 is two years older than Unit 2; during 1976, Unit 2 produced 11% more electrical energy than Unit 1. This example indicates that differences may not be significant in the rates of LER submission between the two units. At Zion, however, reports from the two units at significantly different rates should be for reasons other than randomness.

Results of this study show where statistical variations are significant in numbers of LERs associated with individual reactors for specific reactor systems and components. The full paper contains results of statistical analyses of LERs for all US commercial nuclear plants.

REFERENCE

1. "Review of Licensee Event Reports (1976-1978)," Advisory Committee on Reactor Safeguards, USNRC, NUREG-0572 (September 1979).